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Reforming Electricity Subsidies in Pakistan: Measures to Protect the Poor

Thomas Walker, Sebnem Sahin, Mohammad Saqib and Kristy Mayer

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Abstract

As part of its energy sector reforms, the Government of Pakistan plans to reduce spending on electricity subsidies to 0.3-0.4 percent of GDP by mid-2016. The reforms will alleviate a major constraint on the government's budget. However, they will necessitate increases in the price of electricity, which have the potential to measurably reduce the welfare of the poor. The government will need to carefully design the price increases and provide associated compensation to avoid this outcome.

This paper demonstrates that that it is possible for the government to protect the poor against most of the costs of the reform while at the same time improving the targeting of remaining subsidy expenditures. Measures that can be taken include targeting subsidies based on poverty scores and providing targeted cash compensation to poor households. We illustrate how these measures could be implemented, and estimate their associated welfare impacts.

This Working Paper disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the paper is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

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Abbreviations and Acronyms

BISP	Benazir Income Support Programme
CGE	Computable General Equilibrium
FY	Fiscal Year
GDP	Gross Domestic Product
GTAP-E	Global Trade Analysis Project - Energy Substitution
IMF	International Monetary Fund
kWh	kilowatt hours
NADRA	National Database and Registration Authority
NDT	NEPRA-determined tariff
NEPRA	National Electric Power Regulatory Authority
NPR	National Poverty Registry
PMT	Proxy Means Test
PSLM	Pakistan Social and Living Standards Measurement
Rs	Rupees (Pakistan)
TDS	Tariff Differential Subsidy
TOU	Time of Use
UN	United Nations
WDI	World Development Indicators
WEO	World Economic Outlook
YOY	Year On Year

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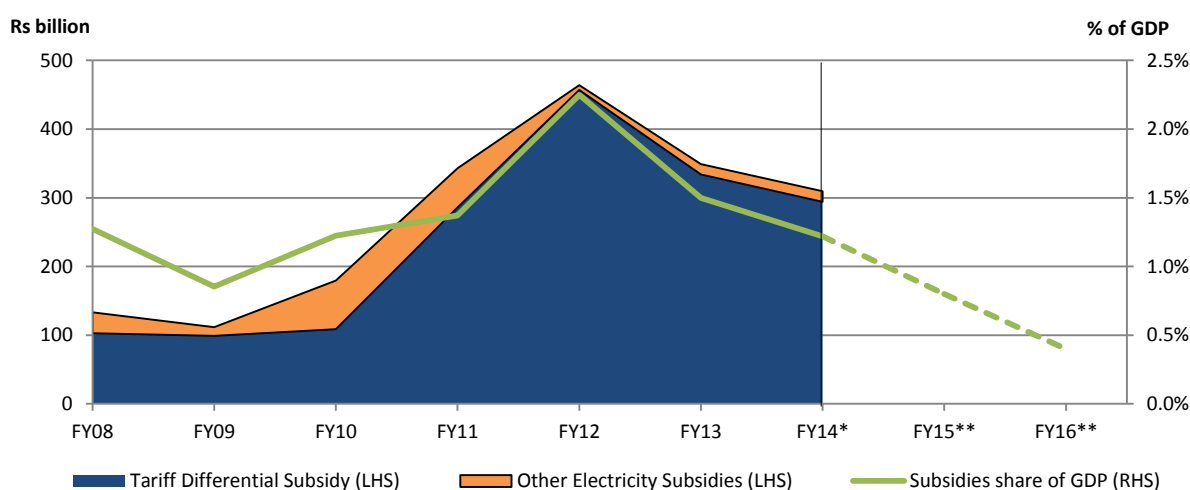
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Electricity Subsidies Largely Benefit Non-Poor Households

1. The Government of Pakistan provides several subsidies to electricity consumers; in 2012-13 (FY 13), these collectively amounted to 1.5 percent of GDP (Figure 1). By far the largest is the Tariff Differential Subsidy (TDS), which comprised 96 percent of electricity subsidies in FY 13. The TDS is a payment from the government to compensate electricity utilities for the difference between their cost-recovery tariffs and lower actual tariffs charged.¹ The government uses the TDS to set a single national tariff for each consumer type and to provide additional subsidies to some consumers.² In FY 13, half of electricity subsidies went to households, one quarter to industry, and the remainder to agriculture and low-consuming businesses.

Figure 1 Electricity Sector Subsidies in Pakistan



Notes: * Estimate based on provisional 2014 NDT (not yet notified). ** Based on 2013 IMF Article IV targets.

2. Subsidies are allocated according to consumer type and electricity use. For households, electricity use is divided into ‘slabs’ (1-100 kilowatt hours (kWh), 101-200 kWh, etc.). Each slab is charged at a separate rate per kWh, and the rate increases from one slab to the next. In FY 13, a household that used 75 kilowatt hours (kWh) of electricity in a month would have paid Rs 5.79 per kWh, while a household that used 750 kWh would have paid Rs 5.79 per kWh for the first 100, Rs 8.11 for the next 200, and so on as indicated in Table 1. It is important to note that even heavy electricity users therefore received concessional tariffs on their initial consumption—and, because almost all tariffs were set at or below cost, the subsidy was larger for heavier consumers (Figure 2).

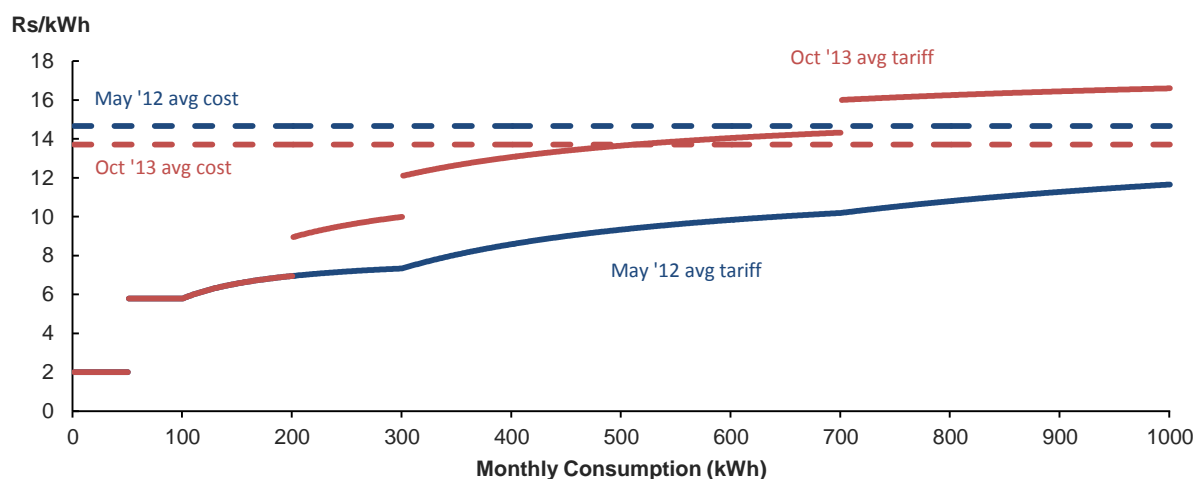
¹ Cost-recovery tariffs are the tariffs which, if paid in full by electricity consumers, would fully cover utilities’ allowed costs. These are determined by the National Electric Power Regulatory Authority (NEPRA).

² The consumer types are residential, commercial/industrial and agricultural. The TDS is used to compensate the higher-cost utilities for receiving insufficient tariff revenue, since some utilities have higher costs than others (e.g. those with more rural consumers).

Table 1 Residential Electricity Tariff Schedules*

Unit of Consumption (Slab)	Tariff per Unit	
	May 2012	Oct 2013
Lifeline Consumers:		
1 to 50 kWh	2.00	2.00
All other consumers:		
1 to 100 kWh	5.79	5.79
101 to 200 kWh	8.11	8.11
101 to 300 kWh	8.11	12.09
301 to 700 kWh	12.33	16.00
701+ kWh	15.07	18.00
Average Cost of Electricity Supply:	14.66	13.70 ³

* Pakistan also charges a time-of-use (TOU) tariff for households with a sanctioned load above 5 kW and a special TOU meter. The TOU tariff varies depending on the time of day that the electricity is consumed. Very few households have a sanctioned load above 5kW, so the TOU tariff is not considered in this analysis. In general, converting households to TOU meters will improve subsidy targeting, as it will charge heavy users cost-recovery tariffs on all consumption.

Figure 2 Average Residential Tariff for Various Consumption Levels

Notes: Excludes minimum monthly charge.

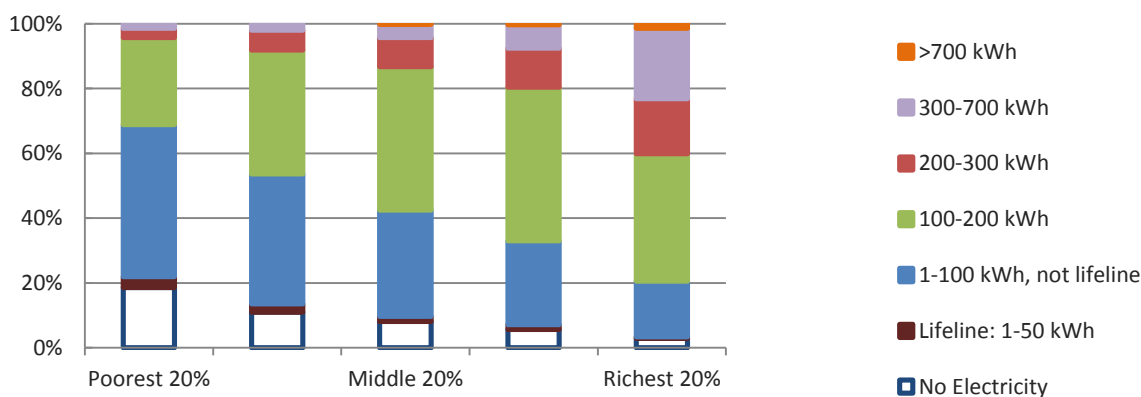
3. A highly concessional 'lifeline tariff' is provided to households that use less than 50 kWh per month. Lifeline tariffs are used in a range of countries (including Ghana, Vietnam, and parts of India) to help the poor afford a minimum amount of electricity. The rate offered to these low-consuming households is well below the rate on the first slab paid by non-lifeline consumers (Table 1). The lifeline tariff in Pakistan is relatively ineffective, however, because only about 3 percent of consumers use less than 50 kWh per month (Figure 3).

³ Provisional NEPRA-determined tariff for FY 14 (not yet notified). The cost of electricity supply is projected to fall from FY 13 to FY 14 because (i) there are fewer prior-year costs to recover (i.e., the difference between actual and projected costs from the previous year) and (ii) the regulator reduced the amount of technical losses it allows utilities to recover through revenue.

4. The government recently modified the tariff structure to limit heavy users' access to concessional rates. In October 2013 (FY 14), the government switched from the above 'all-slab benefit' structure to a 'previous-slab benefit' structure, in addition to increasing tariffs on slabs above 200 kWh per month (Table 1). Under the previous-slab benefit, a household in a given slab now pays the rate on the slab immediately below for all electricity up to that slab's lower bound, and the rate on that slab for the remainder. For example, if a household consumes 750 kWh in a month, it now pays Rs 16 per kWh for its first 700 kWh and Rs 18 per kWh for the next 50. This change limited heavy users' access to concessional rates which, combined with tariff increases on the top three slabs, substantially reduced subsidies for higher levels of consumption. However, most households continue to receive a net subsidy (Figure 2).

5. Despite the recent tariff adjustments, we estimate that only 28 percent of electricity subsidies reach the poor (Figure 4).⁴ There are three reasons for this. First, electricity consumption is only weakly related to poverty, so many non-poor households pay the concessional tariffs granted to low electricity users and thus benefit from subsidies. This can be seen in Figure 3, which shows how the breakdown of household electricity usage varies depending on the size of total monthly expenditure (a proxy for living standards). This policy is still protecting the vast majority of households, even those in the top quintiles. Second, even though the October 2013 notifications notably reduced subsidies for the heavier users, they still granted a net subsidy to households using up to around 500 kWh per month (Figure 2), many of which are non-poor. Third, electricity subsidies provide no benefit to households without electricity access.⁵

Figure 3 Distribution of Households by Electricity Usage, 2010-11

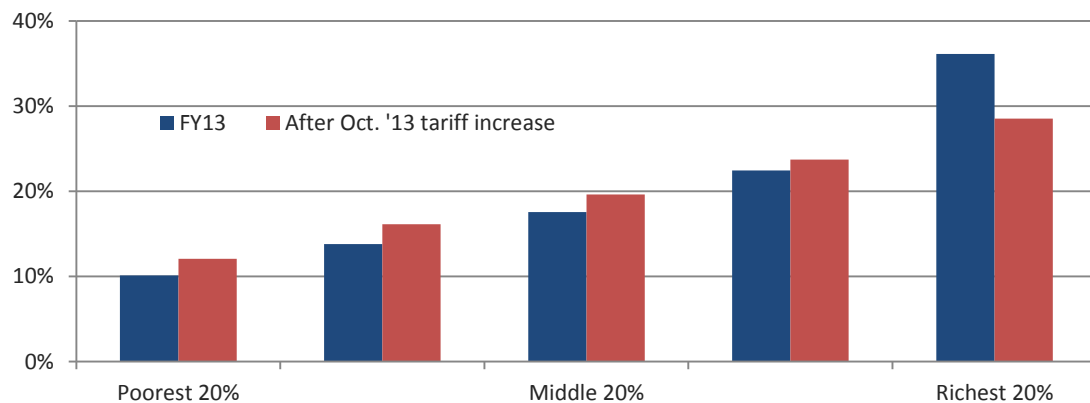


Source: PSLM Survey, 2010-11.

⁴ In this note, we use the term 'poor' to refer to the 40% of households with the lowest living standards in Pakistan (measured by total monthly expenditure). These are households that are either poor by national definition, or are vulnerable to becoming poor if they experience a large shock. We use the term 'extreme poor' to refer to the poorest 20% of households by this measure.

⁵ It was not possible to distinguish precisely from the survey data whether households were officially connected to the grid. In this note, we define 'households without electricity access' as those which reported zero electricity expenditures in the survey. The actual number of households connected to the grid may differ from this estimate if (i) some households were temporarily not paying for an existing connection; or (ii) households reported other types of electricity expenditures in this category (e.g. the cost of batteries, generators or portable power units).

Figure 4 Share of Electricity Subsidies Received by Households, Ranked by Expenditure



Source: PSLM Survey, 2010-11.

Without compensation, subsidy reform would have significant negative impacts on the poor

6. Between FY 13 and FY 16, the government plans to reduce its subsidy bill from 1.5 percent of GDP to 0.3-0.4 percent. Due to the aforementioned October 2013 tariff increases, the 2014-15 budget estimates that subsidies fell to around 1.2 percent of GDP in FY 14. To reach 0.4 percent by FY 16, the government will need to further increase electricity prices. This will have a direct impact on the affordability of electricity, but will also affect economic activity and the price of other goods.

7. In this note we estimate the likely impact of the reforms on household welfare and simulate the effect of various compensation measures. Based on the forecast cost of electricity, we first determine what electricity price increases would be required to meet the subsidy targets. We then use a whole-economy macroeconomic model to predict the impact of the electricity price increases on GDP growth, inflation, and household consumption. Finally, we use household survey data to estimate the likely impact of the reforms and compensation on household welfare, measured as the change in households' cost of living. Details on the modeling process are provided in the Annexure.

8. We consider a reform scenario in which electricity prices increase sufficiently to reach the subsidies targets, and no compensation is provided. This scenario takes as given the October 2013 tariff increase and assumes no further price changes in FY 14. For FY 15 and FY 16, it assumes the lifeline tariff stays fixed but all other residential electricity prices increase by up to 20 percent.⁶ The assumptions are summarized in Tables A1 and A2 (See Annexure). Commercial and industrial prices are both assumed to increase by 14 percent each year, while agriculture sector electricity prices are assumed to remain somewhat subsidized and thus increase by 8 percent in FY 15 and 1 percent in FY 16. The impacts of this scenario are compared to a 'no-reform' baseline in which all prices increase at the same rate as the average cost of electricity supply.⁷

9. Under the reform scenario, macroeconomic modeling predicts that overall prices would increase slightly, and GDP growth would be slightly lower. By FY 16, overall prices would be 1 percent higher due to pass-through of increased electricity costs. The increase in overall prices would slightly dampen real GDP growth, although the impact is minimal. From FY 14 to FY 16, real GDP would grow at an average annual rate of 4 percent, compared to 4.2 percent under the baseline. The effect on household income growth is analogous. The full set of macroeconomic forecasts is presented in Table A3 (See Annexure).

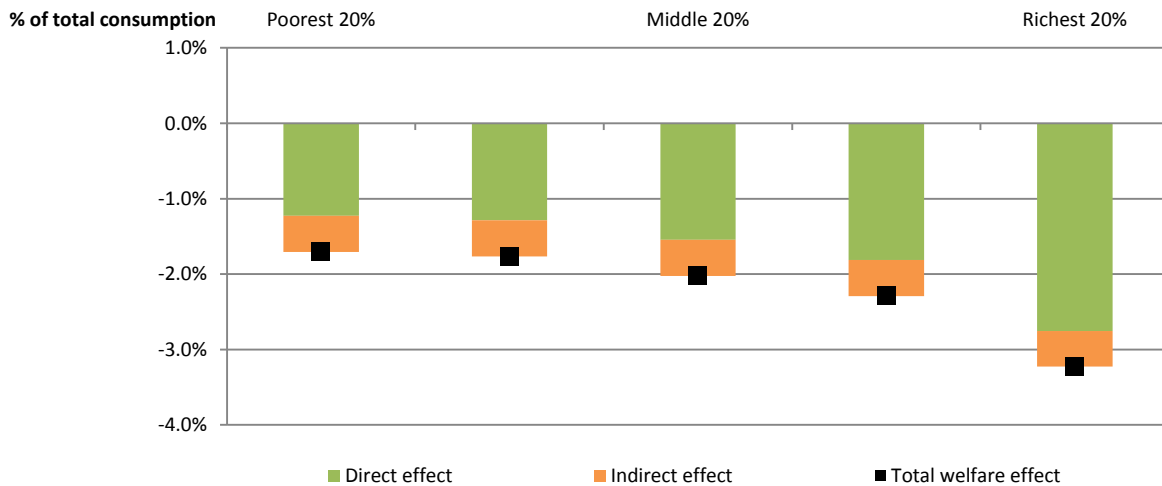
10. Partial equilibrium modeling of household demand indicates that all households would face a welfare loss from the reform. The 97 percent of electricity users who are not currently covered by the lifeline would face a direct welfare effect in the form of higher electricity bills. All households—including lifeline consumers and those without electricity access—would also suffer an indirect welfare effect due to the increase in overall prices,

⁶ We assume that residential tariffs will not be increased above the cost-recovery tariffs determined by NEPRA; for some slabs this means that tariffs will rise by less than 20 percent under the scenario.

⁷ In order to estimate the total effect of the reform, the baseline does not include the October 2013 adjustment, since it occurred as part of the reform process.

however it is important to note that this effect would be relatively small. By FY 16, the welfare of poor households would be 1.7 percent lower, on average, than under the baseline (Figure 5). The impact on wealthier households would be higher both in absolute terms and relative to their total consumption.

Figure 5 Average Welfare Loss Under Reform Scenario (FY16)



Source: Authors' calculations

11. These estimates should be seen as a lower bound on the potential impacts of the broader electricity sector reform agenda. In conjunction with the changes to subsidy policy, the government is undertaking various structural reforms to the energy sector intended to improve its efficiency and capacity. These include addressing financial losses by the utilities, reducing commercial and technical losses, and improving operational and procurement efficiency. It has been estimated that these reforms could increase GDP significantly, in which case the indirect effects presented above may be less negative or even positive.⁸ Therefore these simulations should be seen as a lower bound on the likely welfare impact of the reforms.

⁸ World Bank (2014), 'Program Document for a First Power Sector Reform Development Policy Credit', Report No. 86031-PK, April 3, 2014.

Subsidy design changes and compensation can protect the poor and improve the targeting of public expenditure

12. The above analysis demonstrates that the poor may face a welfare loss as a result of the reforms. Although the impact is not substantial relative to the effects of other economic shocks, the visible rise in the cost of living may strengthen resistance to the reforms and detract from the key message that removing untargeted subsidies frees resources to improve the electricity supply and increase social spending on the poor. Therefore it is advisable for the government to consider some form of targeted compensation to ensure that the poorest households are no worse off as a result of the reforms. In this section we examine three compensation options: (i) providing an immediate top-up to the BISP monthly cash transfer; (ii) targeting subsidies to the poor; and (iii) providing a temporary, targeted cash transfer to the poor.

Provide a top-up to the BISP monthly cash transfer

13. To mitigate the immediate impact of tariff increases on the poorest households, the government will increase the monthly cash benefit paid by the Benazir Income Support Programme (BISP). This benefit is given to the poorest 22 percent of households in Pakistan. The government has just announced a Rs 300 per month top-up to the BISP benefit in order to compensate the poorest households for the costs of the reform. This will raise the benefit per household to Rs 1,500 per month. We estimate that the BISP top-up will on average halve the welfare impact of the reform among the extreme poor (Figure 6).

Figure 6 Average Welfare Loss After BISP Top-up (FY16)



Source: Authors' calculations

14. The government could also consider indexing the BISP monthly cash benefit to inflation. Future reforms and other shocks may further increase prices and adversely affect the welfare of the poor. By indexing the BISP cash transfer to inflation, the poorest households would automatically receive a benefit increase in the event of rises in the cost of living, diminishing the impact on their welfare.

Target subsidies based on poverty indicators

15. If the government wishes to retain electricity subsidies, they should be targeted to the poorest households. In order to do this, it would be necessary to determine who qualifies for compensation. The utility companies have some data on customers that could be used to determine eligibility.⁹ However, these data are unlikely to be good proxies for poverty, and may suffer from inaccuracies or be missing for some households.¹⁰ A preferred option would be to use the existing National Poverty Registry to objectively determine which households are poorest. The National Poverty Registry (NPR) is a national database of poverty scores for each household in Pakistan that is used to deliver other social assistance to the poor (most notably BISP benefits).¹¹

16. Poverty scores are a significantly better indicator than electricity use for targeting subsidies. Targeting the bottom 40 percent of households based on their poverty scores would capture the majority of poor households with electricity access. However, if we take into account those without access, only two-thirds of all poor households would benefit from this policy (Figure 7). If it is not possible to target the bottom 40 percent, and subsidies are restricted to BISP households, only 41 percent of poor households would benefit from targeted subsidies.

Figures Coverage and Benefits of Subsidies

Figure 7. Coverage of Targeted Subsidies by Poverty Score

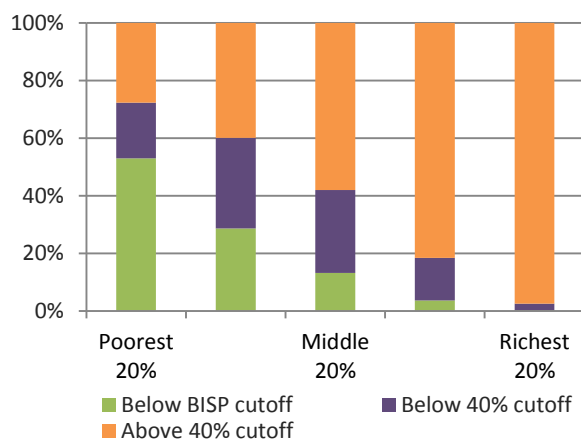
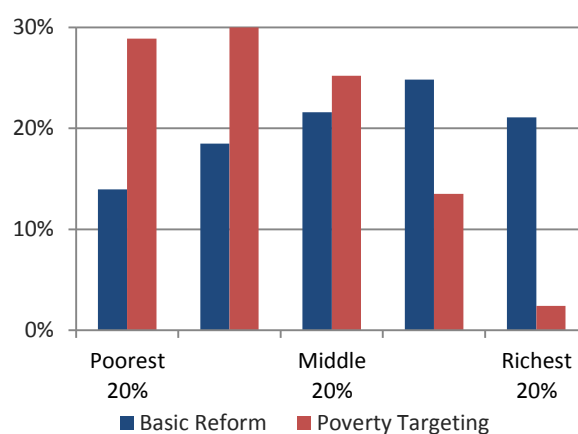


Figure 8. Benefits Incidence of Subsidies (FY 16)



Source: Authors' calculations

⁹ These include house size (e.g., number of rooms), sanctioned electricity load, and geographical area.

¹⁰ For any of these, it would be necessary to evaluate the relationship between the proposed change and poverty before making the changes on the grounds that it would improve targeting. House size, for example, is even less related to poverty than electricity use and so would perform worse than the kWh cut-off as an eligibility criterion. The relationship between other proxies and poverty could not be evaluated with the household survey used in this study.

¹¹ Poverty scores are indexes of household characteristics, including asset ownership and family composition, which provide a relatively good proxy for households' actual poverty status. While not as precise a measure of poverty as total monthly expenditures (used this in paper), poverty scores can be easily constructed for all households based on census data, whereas it is not feasible to collect expenditure data for every household.

17. Targeting subsidies based on poverty scores would allow the government to easily reach its FY 16 subsidy target. In Figure 8, we assume that utilities retain subsidized tariffs for the bottom 40 percent of households by poverty score, and charge everyone else a tariff consistent with cost recovery. This policy would make the remaining subsidies expenditure substantially more progressive, with almost 60 percent of subsidies going to poor households. The subsidy target would easily be reached; retaining existing subsidized tariffs for the bottom 40 percent of poverty scores would cost less than 0.3 percent of GDP.

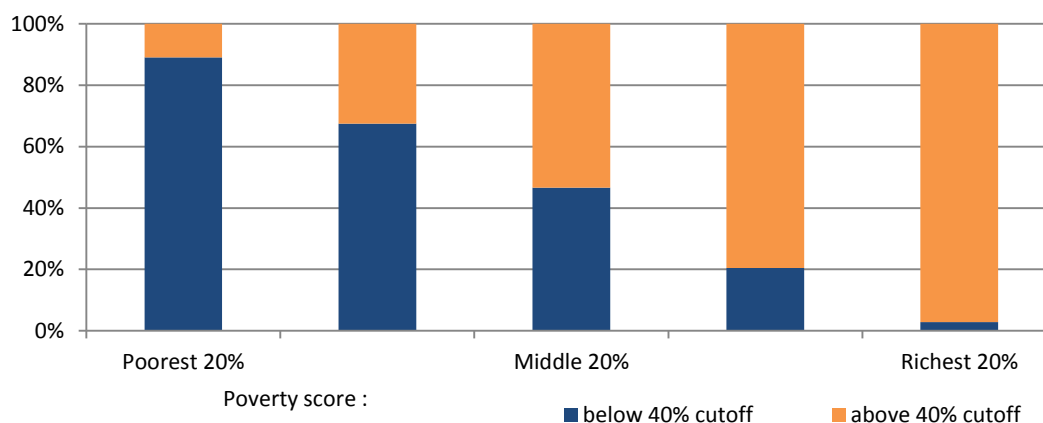
18. Introducing a targeting mechanism would take time to implement, however, and may pose logistical challenges. A feasibility study would be needed to determine whether, and how, the NPR can be merged with utility billing databases. Following this, a process of validation and registration would be required. Thus the shift to targeted subsidies is a medium-term policy option. The government may decide to refrain from tariff increases on the lowest brackets until the targeting system is functional, though doing so would necessitate steeper price hikes for heavier consumers.

19. In addition, targeting subsidies would still exclude many poor households from compensation. To mitigate this, the government could set up a grievance redressal mechanism to allow excluded but genuinely poor households to have their poverty scores reviewed¹², or could consider retaining less generous subsidies for households with higher poverty scores. Even with such measures, targeted subsidies will have no benefit for households without electricity access (currently 15 percent of the poor). In addition, fully targeting subsidies would imply eliminating all subsidies for the non-poor. To reduce the adjustment costs on these groups, the government should consider gradually phasing out subsidies for untargeted households.

Provide a temporary, targeted cash transfer to the poor

20. A temporary cash transfer to the poor would achieve better coverage than targeted subsidies. A cash transfer could be paid to all eligible households through commercial banks. This process has been used previously in Pakistan to compensate victims of natural disasters. The cash transfer could be administered by the Ministry of Water and Power, contracting the National Database and Registration Authority (NADRA) for identification and provincial governments for registration. Community validation can be used to verify the eligibility of households. Registering the bottom 40 percent of households by poverty score (other than those already registered for BISP) would take time to complete. However, this approach has the virtue of compensating all households regardless of electricity access, resulting in coverage of 89 percent of the extreme poor and 78 percent of the poor (Figure 9).

¹² Such a system is presently used to review cases of exclusion in BISP.

Figure 9 Coverage of Cash Compensation to the Bottom 40% of Households by Poverty Score

Source: Authors' calculations

21. The amount of cash compensation required to compensate poor households would be relatively small compared to the anticipated savings from the reform. While the top-up to the BISP benefit fully compensates the extreme poor on average for the welfare effects of the reform in FY 14 and FY 15, a further cash transfer of around Rs 200 per month would be required by FY 16 if the BISP benefit is not indexed. A Rs 200 per month transfer would cost the government less than ten percent of the Rs 132 bn saved in subsidies expenditure in that year alone. If the government chose to compensate all households in the bottom 40 percent with a temporary cash transfer, it would cost Rs 44.2 bn (for a transfer of around Rs 300 per month per household). Even allowing for the cost of implementing this compensation, these amounts are easily affordable given the fiscal savings from the reform.

Adequate compensation and clear communication are essential to ensure the sustainability of energy subsidies reforms

22. International experience has shown that strengthening social safety nets and demonstrating a commitment to protecting the poor are essential components of successful energy subsidy reform. To ensure the reforms are broadly accepted and politically sustainable, the government should put in place measures to minimize or mitigate negative welfare impacts on the poor. This paper proposes three compensation measures: adjustments to BISP benefits; targeting remaining residential electricity subsidies based on poverty scores; and providing temporary, targeted cash compensation to poor households.

23. A combination of measures may be necessary to balance the immediate need to protect the poorest with the ultimate objective of compensating the poor and improving targeting. The government has already announced a top-up benefit to the BISP monthly cash transfer, a measure that will partly compensate beneficiary households for the reforms. We recommend the government also consider indexing the BISP benefit to inflation to cushion beneficiaries against future energy price increases. In the medium term, the government could move from targeting subsidies based on electricity consumption to targeting based on poverty scores, or replace tariff subsidies with targeted cash transfers. These latter measures will take time to implement, given the need for feasibility studies and the roll-out of the targeting and registration systems. In the meantime, a variety of other measures could also help alleviate the short-run impact of the reform on consumers. These include timing tariff increases to coincide with periods of low electricity use, promoting energy efficiency, and improving the efficiency of electricity generation and distribution.

24. Finally, the government should develop a comprehensive communications campaign for the reforms, tailored to a variety of audiences. The campaign should reassure the public that the poor will be protected against the welfare impacts of the reform, and provide a clear roadmap for the reform process. The government can use the communications campaign to explain the benefits of the reform, such as improved infrastructure investment and electricity service, better targeted social spending, and more sustainable fiscal expenditures.

Annexure

This Annexure describes the methodology and assumptions underlying the analysis. Our analytical framework has three parts. First, we forecast the average cost of electricity supply for FY 14, FY 15, and FY 16. We calculate the increases in electricity prices required to lower electricity subsidies from 1.5 percent of GDP in FY 13 to 1.2 percent in FY 14, 0.7 percent in FY 15, and 0.4 percent in FY 16. Second, we use a Computable General Equilibrium (CGE) model for Pakistan to forecast what impact these price increases will have on GDP growth, household income and inflation. Finally, we use the latest available national household survey data to model the household-level welfare implications of these macroeconomic forecasts under various compensation scenarios.

Part A: Subsidy Targets & Tariff Changes

For the cost of electricity supply, we use the weighted average NEPRA-determined tariff (NDT) across all utilities in Pakistan. For FY 14, we use provisional NDTs, which suggest the average cost will be Rs 13.70 per kWh. We assume changes in the NDTs will be driven by a combination of fuel oil prices (60 percent weight) and overall inflation in Pakistan (40 percent weight). The price of fuel oil is taken from staff estimates, and is forecast to decline gradually to USD 89.30 per barrel in FY 16. For inflation we use figures from the IMF World Economic Outlook (October 2013), augmented by the estimated marginal effect of electricity price changes taken from the CGE model. Overall inflation for the baseline scenario is expected to pick up to 8.9 percent in FY 15, then drop to 6.9 percent in FY 16. Inflation forecasts under the reform scenario are about one percentage point higher. These give a projected average cost in FY 16 of Rs 15.54 per kWh for the baseline, and Rs 15.63 per kWh for the reform scenario.

To calculate total electricity subsidies as a share of GDP, we take the per-unit difference between the projected NDT for each consumer class and the electricity price charged to each consumer class and multiply that difference by the amount of electricity consumed by each consumer class. We then sum those amounts across consumer classes to calculate the total electricity subsidy needed, and divide that figure by GDP. This calculation implicitly assumes that electricity subsidies are defined as the payments the government needs to make to all of the utilities to compensate them for the difference between their allowable costs and tariff revenues (this is the definition of the Tariff Differential Subsidy, or TDS).¹³ We assume that electricity consumption by each consumer class increases at the same rate as GDP.

¹³ If the IMF expanded its definition of subsidies to also include, for example, the equity given by the government to the power sector to clear accrued debt for mismatches between payments made and revenue received, then a larger electricity price increase would be required to bring total electricity subsidies down to 0.4 percent of GDP. That would magnify the impacts on the poor presented here and require higher compensation.

We develop a reform scenario for electricity prices the government might set to achieve the subsidies reduction targets. We assume that an equalization surcharge (or other mechanism to maintain uniform national tariffs without a government subsidy) is applied to charge consumers a price above the minimum NDT and shift revenue from lower-cost utilities to higher-cost utilities.¹⁴ The October 2013 tariff increase is taken as given and there are no additional FY 14 price increases. For FY 15 and FY 16, the lifeline tariff stays fixed but all other residential electricity prices increase by up to 20 percent.¹⁵ Commercial and industrial prices are both assumed to increase by 14 percent each year, while agricultural prices are assumed to remain somewhat subsidized, increasing by 8 percent in FY 15 and 1 percent in FY 16. Table A1 details the average increases assumed in this scenario, and Table A2 details the tariff schedules assumed for residential consumption.

Table A1 Electricity Price Increases Under Reform Scenario (Annual Nominal Increase)

	FY14	FY15	FY16
Residential	21%	18%	16%
Commercial	21%	13%	14%
Industrial	36%	13%	14%
Agriculture tube wells	23%	8%	1%

Table A2 Residential Electricity Tariffs Under Reform Scenario (Rs per kWh)

	FY14	FY15	FY16
Lifeline: Up to 50 kWh/month	2.00	2.00	2.00
1-100 kWh	5.79	6.89	8.27
101-200 kWh	8.11	9.65	11.58
101-300 kWh	12.09	14.39	17.26
301-700 kWh	16.00	18.59	19.72
700+ kWh	18.00	20.58	21.83

Note: From October 2013, residential tariffs (aside from the lifeline tariff) follow a 'previous-block tariff' structure, where households are charged two rates for their consumption: one rate for the final bracket they fall in for all consumption in that bracket, and the rate from the lower bracket for all consumption below the cut-off for the final bracket. For example, a household consuming 750 kWh in one month in FY 15 would pay Rs 18 for its 701st-750th kWh and Rs 16 for its 1st to 700th kWh.

Part B: Macroeconomic Model

We use the Global Trade Analysis Project Computable General Equilibrium Energy Substitution (GTAP-E CGE) model to simulate the whole-economy impacts of the subsidy

¹⁴ This assumption does not change how we would calculate the prices charged to each consumer class. However, without the assumption of this or another revenue-transfer mechanism, even if consumer prices were set equal to the weighted average NDT, the government would still have to pay a subsidy to compensate higher-cost utilities for charging consumer prices below their cost-recovery tariffs. Assuming an equalization surcharge or other revenue-transfer mechanism means we are assuming the government can essentially transfer revenue from lower-cost utilities (for whom the uniform national tariffs applied are above their cost-recovery tariffs) to higher-cost utilities.

¹⁵ We assume residential tariffs will not be increased above the cost-recovery tariffs determined by NEPRA; for some slabs this means that tariffs will rise by less than 20 percent under the scenario.

reduction path and price increases detailed above.^{16,17} We then use the outputs of the CGE model as parameter settings for a partial-equilibrium model of household demand (described in the next section), which yields estimates of the welfare effects of the reforms and potential compensatory measures.

Main Simulation Results

In the macroeconomic modeling stage, GTAP-E model simulations yield for FY 14, FY 15 and FY 16 the household consumption, income growth and average price changes under the baseline and reform scenarios. The modeling exercise comprises two parts. First, we developed a baseline using the built-in dataset for Pakistan in the GTAP-E model (based on GTAP database version 8). Economic growth rates are taken from IMF country reports; other parameters (e.g. population growth) for the baseline are taken from the IMF World Economic Outlook (WEO) database, WDI, UN Data and other official forecasts. Second, we developed a set of scenarios based on the projected increases in consumer electricity prices and decreases in government subsidy expenditures described previously.

The model distinguishes electricity as a separate consumption item in the household budget. On the supply side, electricity is produced using three different types of energy (coal, natural gas and fuel oil) that are either domestically produced or imported. The baseline is developed on the hypotheses that world fuel oil prices (the main input used in electricity production in Pakistan) will decrease over the next three years.¹⁸ The removal of subsidies is treated as an exogenous shock on producer and consumer prices. Each consumer type is affected differently as a result of the removal of electricity subsidies (as described in Table A1). On the production side, the CGE model describes the pass-through effect of subsidy removal in terms of possible increases of producer prices, which is likely to result in an increase in the average price level. Simultaneously, favorable trends in the world oil market predicted for FY 14 and FY 15 will help to attenuate the inflationary impact of subsidy removal. Energy intensive sectors are predicted to be the most affected by rising electricity prices. On the consumer side, two effects are predicted. The Pakistan economy will perform better under the IMF program; faster growth would result in increased income levels (both for skilled and unskilled labor) in the medium term (Table A3).

Table A3 Predicted Macroeconomic Impacts of the Reform

	FY 13	FY 14	FY 15	FY 16
Baseline scenario				
GDP (constant USD billions, 2007)	134.1	138.9	144.3	151.5
GDP growth (yoy % change)	2.80	3.60	3.94	5.15
Household income (yoy % change)	3.38	3.59	3.41	4.68
Consumer prices (average, yoy % change)	8.33	8.26	8.87	6.88
Reform scenario				
GDP (constant USD billions, 2007)	134.1	138.4	143.7	150.8
GDP growth (yoy % change)	2.80	3.25	3.78	4.96
Household income (yoy % change)	3.38	3.24	3.19	4.74
Consumer prices (average, yoy % change)	8.33	8.28	8.99	7.37

¹⁶ For this exercise, only the price increases in Table A1 were simulated.

¹⁷ For further details, see Hertel, T. W. (1997), *Global Trade Analysis, Modeling and Applications*, Cambridge, Cambridge University Press, <https://www.gtap.agecon.purdue.edu/>

¹⁸ http://www.worldbank.org/content/dam/Worldbank/GEP/GEP2014a/Commodity_Markets_Outlook_2014_January.pdf

General assumptions				
World fuel oil prices (yoy % change, constant 2010 USD)	0.00	0.10	-2.14	-4.49

Part C: Household-level Model

We apply the outputs from the macroeconomic modeling to a partial-equilibrium model based on the 2010-11 Pakistan Social and Living Standards Measurement (PSLM) Survey. The model takes observed electricity consumption for FY 11 and projects it forward to FY 13 based on consumption growth, inflation and changes in electricity tariffs. We assume there are no demographic or technological changes over that time and that total household consumption grows uniformly at the rate predicted by the CGE model. However, we allow each household's electricity demand to evolve over time based on income and price growth rates and associated demand elasticities. From FY 14 to FY 16 we forecast electricity consumption and total household consumption under the baseline and reform scenarios. A cost of living index is calculated for each household based on electricity and non-electricity prices and their respective expenditure shares. The welfare impact of the reforms is found by comparing real consumption under the baseline and reform scenarios (valued at reform scenario prices).

In this model, the reforms have three channels of impact on households: (i) a growth effect, captured by the CGE model's estimates for GDP growth; (ii) a direct effect on electricity prices and demand, captured by the price of electricity in the cost of living index and the elasticity of demand for electricity; and (iii) an indirect effect on other prices, estimated through the CGE model and applied to real consumption through the cost of living index. We then simulate a range of different scenarios using assumptions about cash transfers that the government might provide to compensate for the negative impact of the reforms (described in the next section), and estimate how these affect the overall welfare calculus for each consumption quintile.

For a given household i , the implied quantity of electricity consumed by each household each month, c_i , is recovered from the observed monthly electricity expenditure, x_i (net of taxes and charges¹⁹), by inverting the all-slab benefit pricing formula which was in effect during the survey period and applying the prevailing tariff, tax and fee rates in 2010-11:

$$x_{i,t} = \begin{cases} 75 \text{ if } c_{i,t} \leq \frac{75}{p_1} \\ p_1 c_{i,t} \text{ if } c_{i,t} \in \left] \frac{75}{p_1}, b_1 \right] \\ p_2 c_{i,t} \text{ if } c_{i,t} \in]b_1, b_2] \\ \sum_{j=2}^{k-1} p_j (b_j - b_{j-1}) + p_k (c_{i,t} - b_{k-1}) \text{ if } c_{i,t} \in]b_{k-1}, b_k] \\ \text{for } k = 3, \dots, n \end{cases}$$

¹⁹ The calculations used to recover electricity expenditure before taxes and charges are omitted for clarity and are available upon request. The taxes accounted for in this calculation are: (i) VAT of 17%; (ii) excise duty of 1.5%; (iii) a Neelum-Jhelum surcharge of Rs 0.10 per kWh for non-lifeline consumers; and (iv) a Rs35/month Pakistan television fee for those households with a television.

where p_j is the tariff per kWh in bracket j , b_j is the upper bound for bracket j , and n is the total number of brackets. Note that there is a minimum charge of Rs 75 per household per month, and that the lifeline tariff rate, p_1 , applies only to consumers below b_1 (currently 50 kWh per month). Otherwise, all households benefited from the tariff in each bracket.

We assume that the household's total expenditure grows each year at the same rate as nominal household consumption (obtained from the CGE model). The quantity of electricity consumed is updated each year based on the change in the marginal price of electricity for each household, $dp_{i,t}$, and real household consumption growth, g_t , according to the following formula:²⁰

$$c_{i,t} = c_{i,t-1}(1 + \varepsilon dp_{i,t} + \eta g_t)$$

where $\varepsilon = -0.17$ is the price elasticity and $\eta = 0.8$ the income elasticity of demand for electricity.²¹ The change in the marginal price of electricity is just the change in the tariff for the block in which the consumer was located in the previous year.

Using the formula above for $x_{i,t}$, we update the household's electricity expenditure in each subsequent year based on projected consumption. Under the previous-slab benefit formula adopted in October 2013, the calculation becomes:

$$\tilde{x}_{i,t} = \begin{cases} 75 \text{ if } c_{i,t} \leq \frac{75}{p_1} \\ p_1 c_{i,t} \text{ if } c_{i,t} \in \left] \frac{75}{p_1}, b_1 \right] \\ p_2 c_{i,t} \text{ if } c_{i,t} \in]b_1, b_2] \\ p_{k-1} b_{k-1} + p_k (c_{i,t} - b_{k-1}) \text{ if } c_{i,t} \in]b_{k-1}, b_k] \\ \text{for } k = 3, \dots, n \end{cases}$$

As discussed in the text, for the time being there is an artefact in the tariff calculation for consumers in the fourth bracket (201-300 kWh), who pay the second bracket (1-100 kWh) tariff for their first 200 kWh. This is also accounted for in our calculations.

Defining μ_t as the unit cost for electricity at time t , the subsidy to the consumer can be calculated as follows:

$$S_{i,t} = \mu_t c_{i,t} - x_{i,t}.$$

We will refer to the total cost of electricity, including taxes and fees, as $x_{i,t}^*$. We keep taxes and fees separate in the calculation of the subsidy bill, since these revenues do not accrue to the ministry responsible for subsidies. The welfare effect of the reforms is defined as the amount of compensation $\tau_{i,t}$ in current rupees that each household would need to receive in order to enjoy the same real consumption under the scenario as they would have under the

²⁰ This formula can easily be obtained by applying the Envelope Theorem to the first-order conditions of a standard, two-good consumer maximization problem.

²¹ These estimates are taken from Hertel et al (1997, op. cit.).

baseline.²² Let $I_{i,t}^B$ be the cost of living index for consumer i in period t under the baseline assumptions, and $I_{i,t}^S$ be the counterfactual cost of living for the same consumer under the reform scenario. Then we can define $\tau_{i,t}$ as follows:

$$\frac{c_{i,t}^S + \tau_{i,t}}{I_{i,t}^S} = \frac{c_{i,t}^B}{I_{i,t}^B}$$

Rearranging for $\tau_{i,t}$, we have:

$$\tau_{i,t} = c_{i,t}^B \frac{I_{i,t}^S}{I_{i,t}^B} - c_{i,t}^S$$

We define the cost of living indices $I_{i,t}^B$ and $I_{i,t}^S$ following a chained Laspeyres price index with two goods: electricity, and all other items. The expenditure share of electricity (s_i^e) is estimated from the household survey data. The cost of living index is then defined individually for each household as follows:

$$I_{i,t} = \frac{(1-s_i^e)NE_t + s_i^e E_{i,t}}{(1-s_i^e)NE_0 + s_i^e E_{i,0}}$$

where NE_t is the CPI estimated in the CGE model and $E_{i,t}$ is a household-specific index of the average cost of electricity including taxes and fees (relative to the base year 0):

$$E_{i,t} = \frac{x_{i,t}^*/c_{i,t}}{x_{i,0}^*/c_{i,0}}$$

It is important to note that we define the cost of living index relative to the base year in every case, so that the welfare comparison between baseline and counterfactual in each year measures the *cumulative* impact of all reforms up to that point.

Cash Transfer Modeling

We simulate cash transfer scenarios for two beneficiary groups: (a) existing BISP beneficiaries and (b) the poorest 40 percent of households ranked by PMT score. We assume that Pakistan would use this database to identify households to receive the cash transfer. The PSLM does not have PMT scores for each household, so we construct a PMT score using the official formula and equivalent variables from the survey.

For each household, the simulated probability of receiving compensation, ρ_i , is defined as follows. For the first simulation, ρ_i is the propensity of BISP receipt for each (rounded) PMT score, taken from the poverty scorecard database for BISP beneficiaries. For a given centile of the PMT score distribution, ρ_i is estimated by taking the observed population share of that PMT score range, and dividing it by the corresponding population share from the PSLM (which is representative of the entire population). The result is then scaled so that the population total of the ρ_i sums to 1. For the second simulation, the reference group is all households at or below the 40th percentile of the PMT distribution (equivalent to a PMT

²² In demand theory this is referred to as the *compensating variation*. The calculations here assume a money-metric utility function for simplicity, although the same results hold as long as we ignore the effects of relative price changes on baseline spending patterns.

score of 26.2).²³ We assume that all households with a PMT score below this cutoff receive a cash transfer, so that $\rho_i=1$ if the PMT score is less than 26.2 and $\rho_i=0$ otherwise.

We use an iterative program to solve for the compensation budget that exactly compensates the reference group, on average, for the impacts from the subsidy reform. The total budget, T_t , which fully compensates beneficiaries in the reference group (on average) for the welfare effect of the reforms in year t is defined as follows:

$$T_t = \sum_{i=1}^n \rho_i w_i \tau_t$$

We then solve for the values of τ_t that achieve full compensation on average:

$$\sum_{i=1}^n w_i \left(c_{i,t}^B \frac{I_{i,t}^S}{I_{i,t}^B} - c_{i,t}^S - \tau_t \right) = 0$$

where w_i is the frequency weight of household i , and n is the number of eligible sample households.

²³ In practice, the actual cutoff would need to be determined based on the poverty scorecard database.